RES MEDICA
Journal of the Royal Medical Society

Anaesthesia in Patients with Cardiac or Respiratory Disease

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Abstract

The degree and frequency of difficulties associated with anaesthesia depends primarily on the skill and experience of the anaesthetist. However, with the increase in life expectancy and advance in anaesthesia and surgery, a greater number of patients previously considered unfit are now being submitted to surgical operations. In many of these patients incidental cardiovascular, respiratory or other disease, frequently of long-standing, may present problems in the conduct of anaesthesia. Furthermore, many drugs used in the treatment of these conditions can potentiate or modify the pharmacological actions of anaesthetic, analgesic and muscle relaxant drugs and increase the risk of accidents and complications during and following anaesthesia. I t is clear, therefore, that the degree of anaesthetic risk may be quite unrelated to the extent of the surgical procedure. For example, the quite major operation of gastrectomy in a generally healthy young man is, from the anaesthetist's point of view, a relatively safe and simple procedure, whereas the extraction of a few teeth in a patient with a history of a recent myocardial infarction or with severe asthma may be fraught with considerable danger. Not infrequently, of course, patients with severe heart or lung disease may require a major surgical operation, either for the treatment of the cardiac or pulmonary disease or for some other serious surgical condition and, in such circumstances, the overall risk is still greater. Although it is often quite impossible to eliminate the anaesthetic dangers associated with concurrent disease or to bring about its rapid and spectacular cure, nevertheless the risk can generally be considerably reduced by careful preparation of the patient before anaesthesia and surgery. Even the knowledge that the disease is present or that the patient is receiving certain drugs can go a long way to reducing the risk of accident by alerting the anaesthetist to the possibility of abnormal reaction to anaesthetic drugs.

ISSN: 2051-7580 (Online) ISSN: 0482-3206 (Print)
Res Medica is published by the Royal Medical Society, 5/5 Bristo Square, Edinburgh, EH8 9AL

Res Medica, Winter 1965-66, 5(1): 24-28
doi: 10.2218/resmedica.v5i1.448

ANAESTHESIA IN PATIENTS WITH CARDIAC OR RESPIRATORY DISEASE

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From a talk delivered before the Royal Medical Society on 29th October. 1965.

The degree and frequency of difficulties associated with anaesthesia depends primarily on the skill and experience of the anaesthetist. However, with the increase in life expectancy and advance in anaesthesia and surgery, a greater number of patients previously considered unfit are now being submitted to surgical operations. In many of these patients incidental cardiovascular, respiratory or other disease, frequently of long-standing, may present problems in the conduct of anaesthesia. Furthermore, many drugs used in the treatment of these conditions can potentiate or modify the pharmacological actions of anaesthetic, analgesic and muscle relaxant drugs and increase the risk of accidents and complications during and following anaesthesia. It is clear, therefore, that the degree of anaesthetic risk may be quite unrelated to the extent of the surgical procedure. For example, the quite major operation of gastrectomy in a generally healthy young man is, from the anaesthetist's point of view, a relatively safe and simple procedure, whereas the extraction of a few teeth in a patient with a history of a recent myocardial infarction or with severe asthma may be fraught with considerable danger. Not infrequently, of course, patients with severe heart or lung disease may require a major surgical operation, either for the treatment of the cardiac or pulmonary disease or for some other serious surgical condition and, in such circumstances, the overall risk is still greater. Although it is often quite impossible to eliminate the anaesthetic dangers associated with concurrent disease or to bring about its rapid and spectacular cure, nevertheless the risk can generally be considerably reduced by careful preparation of the patient before anaesthesia and surgery. Even the knowledge that the disease is present or that the patient is receiving certain drugs can go a long way to reducing the risk of accident by alerting the anaesthetist to the possibility of abnormal reaction to anaesthetic drugs. For example, patients who are currently taking monoamine oxidase inhibitors for the treatment of depression may occasionally show a profound reaction to analgesic or vasopressor drugs. It is quite probable that the possibility of such treatment may have been overlooked by the anaesthetist in his pre-operative examination, unless the physician or general practitioner who is responsible for prescribing these antidepressant drugs has been careful to mention the fact in his letter to the hospital or has impressed on the patient the importance of informing the anaesthetist about his treatment for this seemingly quite unrelated condition.

Where the operation is one of election the patient will usually have been under the care

of a physician before being referred to surgery and the necessary therapeutic measures carried out to bring him into the best possible condition for operation. In the case of patients admitted from the surgical waiting list, or more particularly, in patients admitted to hospital for emergency surgery, the existence of concurrent disease of the heart or lungs may be quite unsuspected. While the anaesthetist has a major responsibility for assessing the fitness of all his patients for anaesthesia it is in the latter group that careful pre-operative examination and assessment is most important if accidents are to be avoided.

It would be impossible to review even briefly in a short article all the potential risks of anaesthesia in patients with concurrent 'medical' diseases and it is proposed, therefore, only to outline some of those met with in surgical patients with coexistent cardiac and respiratory disease and to indicate how these can be avoided or treated.

ANAESTHESIA IN PATIENTS WITH HEART DISEASE

Pre-operative period.

The pre-operative functional status as judged from the patient's history is usually of more value in assessing the degree of risk than the type of heart disease which is present. However, in certain types of heart disease the risk is particularly increased and every effort should be made to control or correct factors such as tachycardia, infection and anaemia which may precipitate arrhythmias and heart failure during anaesthesia and surgery. On the other hand, in patients requiring emergency surgery, as for closure of a perforated ulcer or control of haemorrhage, although treatment of the coexisting heart disease will be limited, a knowledge of its presence and of current drug-therapy will reduce the risk of accident.

Patients with coronary artery disease are especially subject to increased risk when signs of heart failure are present. In those patients who give a history of angina pectoris of increasing severity and with less and less provocation or where there is a history of myocardial infarction within the preceeding three months, operation should be postponed unless the surgical indication is urgent. This also applies to patients with remediable conditions such as hyperthyroidism or myxoedema in which appropriate drug treatment will allow the subsequent operation to be performed with greatly reduced risk.

Many patients with heart disease show a nervous tachycardia which may precipitate heart failure. This risk is considerably reduced by adequate pre-operative sedation. When auricular fibrillation is present with a rapid ventricular rate, an attempt must be made to control this with digitalis before anaesthesia is begun. The dose of digitalis administered will depend on the time available before surgery and on the previous treatment but, whenever possible, the operation should be postponed to allow digitalisation by the oral route to restore a normal ventricular rate and to control the heart failure. On the other hand, unnecessary delay and attempts to treat long standing auricular fibrillation in elderly patients with only minimal signs of failure are unwarranted and unlikely to improve significantly the risk of anaesthesia and surgery.

When a mechanical restriction to heart action is present, as in patients with constrictive pericarditis or aortic stenosis, ability to adapt the cardiac output to compensate for alterations in venous return or myocardial activity is impaired and they are, therefore, less able to withstand deep anaesthesia and rapid blood loss. Circulatory arrest due to asystole, ventricular tachycardia or ventricular fibrillation may occur in cases with heart block, especially where a history of Adams-Stokes seizures is obtained. The risk may be increased if conduction is further impaired by digitalis.

Care should be taken with intravenous infusions of blood or fluid in patients with heart disease for, when these are given rapidly or in excessive amounts, heart failure may be precipitated. This is particularly serious in patients with coronary or valvular heart disease when acute left sided failure with pulmonary oedema may ensue.

Patients with well compensated rheumatic heart disease or systemic hypertension generally withstand anaesthesia well and, if this is properly managed, the risk is little more than in a patient with a normal heart.

Anaesthetic management

Despite the various effects of different anaesthetic agents on the heart and circulation

the skill and care with which they are administered is, by and large, of greater importance than the choice of anaesthetic drug. It is clear, therefore, that scrupulous attention to detail, rather than alterations in technique, is of greatest importance in anaesthesia for cardiac patients.

During induction, care must be taken to avoid hypoxia and hypotension. It is desirable to allow the patient to breathe oxygen for a few minutes to remove nitrogen from the lungs before starting the administration of the anaesthetic. This will reduce the risk of hypoxia and speed the induction of inhalational anaesthesia with nitrous oxide or cyclopropane. In orthopnoeic patients it is most comfortable for them to start the induction in the sitting-up position, but when an intravenous barbiturate drug is used to induce anaesthesia the patient should be supine as there is a danger of a sudden fall in blood pressure due to myocardial depression and vaso-dilatation. When endotracheal intubation is required this is best carried out with the aid of a muscle relaxant drug so that laryngeal reflexes are suppressed and the risk of spasm and reflex cardiac effects reduced.

During maintenance of general anaesthesia the emphasis is on the avoidance of hypoxia and hypercarbia. This entails the use of an oxygen-rich gas mixture, a clear airway and efficient pulmonary ventilation. If muscle relaxants are employed or central respiratory depression occurs, breathing must be controlled. Blood loss at operation must be carefully measured and, when transfusion is necessary intravenous fluids must be given slowly and cautiously, a careful watch being maintained for early signs of heart failure. Arrhythmias, usually extrasystoles, frequently occur during general anaesthesia and are rarely serious in patients with normal hearts. In patients with heart disease, however, all cardiac irregularities must be viewed with concern, particularly if they are associated with a rapid ventricular rate. Ventricular arrhythmias may be due to a direct effect of the anaesthetic on the heart or to the release of endogenous catecholamines in response to carbon dioxide retention or hypoxia. Steps should, therefore, be taken to reduce carbon dioxide and improve oxygenation but, if these are ineffective, a small intravenous dose of one of the new beta receptor-blocking drugs, pronethalol or propranolol, may be used to suppress the arrhythmias.

Many drugs used in the treatment of heart disease may, through their therapeutic action or by side-effects, give rise to untoward reactions during anaesthesia. Digitalis and quinidine may increase the risk of serious arrhythmias although of course, their proper use to prepare certain patients for surgery is fully justified. All the drugs commonly used to produce diuresis in patients with heart disease act by inhibiting the renal tubular reabsorption of electrolytes and are, therefore, liable to produce changes in acid-base balance and potassium depletion. The risk of carbon dioxide retention during anaesthesia in patients receiving these drugs is, therefore, of more serious significance and the response and duration of action of muscle relaxant drugs may be altered. Many drugs used in the treatment of hypertension may potentiate the action of the neuromuscular blocking drugs used to produce muscular relaxation during anaesthesia. They also increase the risk of serious hypotension during anaesthesia and, even when their administration has been withheld for some days before operation, in the case of rauwolfia compounds and guanethidine, which deplete catecholamine stores in the tissues, hypotension and bradycardia are liable to occur during general anaesthesia.

Regional analgesia techniques have a useful place for extra-abdominal procedures in patients with heart disease but epidural and spinal analgesia are generally unsuitable because of the risk of hypotension.

Post-operative period

While most surgical patients with heart disease who have been carefully prepared and anaesthetised tolerate anaesthesia and operation well, there is likely to be an increase in the incidence of complications and in mortality rate following surgery in these cases. Although the frequency of such complications as atelectasis, infection and purely surgical complications is no greater than in patients with normal hearts, they are more likely to be serious. This is because cardiac patients are constitutionally less able to withstand the additional strain and because even minor complications may precipitate some cardiac derangement such as acute cor pulmonale following pulmonary embolism or heart failure secondary to chest complications. A careful watch must be maintained in the post-operative period for arrhythmias, signs of acute coronary insufficiency and heart failure and measures taken to eliminate such predisposing factors as anaemia and over transfusion.

ANAESTHESIA IN PATIENTS WITH RESPIRATORY DISEASE

Pre-operative period

In most surgical patients with concurrent respiratory disease the investigation of the latter is usually restricted to history and physical examination and X-ray of the chest. Whether this is adequate or not depends on the extent and severity of the respiratory condition, its susceptibility to therapeutic measures and the urgency and nature of the surgical procedure contemplated. If time allows, it may be advisable in some cases with severe respiratory dysfunction to assess the degree of respiratory disability by pulmonary function tests. The precise tests employed will, of course, depend on the nature of the disease process, but in general those designed to measure the mechanical factors in breathing, such as the timed vital capacity or maximum ventilatory volume, are most helpful. However, even such simple tests as the patient's ability to blow out a lighted match at a distance of six inches can give useful information about the degree of airway obstruction. The ultimate efficiency of respiration can be assessed by estimating the arterial oxygen and carbon dioxide tensions, but this is only employed when ventilatory failure is present or anticipated.

In patients where the respiratory disease is acute the operation should, if possible, be postponed but, even in chronic cases, a few days' delay may allow measures to be taken which will make the conduct of anaesthesia safer and reduce the risk of post-operative complications. Such measures include the control of chronic infection by appropriate antibiotic therapy, tapping of pleural effusions, evacuation of secretions and instruction in physiotherapy, reduction in airway obstruction by bronchodilator drugs and the treatment of right-sided heart failure secondary to chronic lung disease.

Drugs such as opiates, barbiturates and pethidine which depress respiration should be used sparingly in these cases before operation. Although atropine is usually given in the pre-operative period to reduce secretions during anaesthesia the dose should not be excessive as viscid secretions are difficult to expectorate and may produce areas of collapse by blocking fine bronchioles in patients who are already susceptible to respiratory complications.

Anaesthetic management

At first sight it might be thought that local or regional analgesia would be most satisfactory for patients with coexisting respiratory disease, but whether these are indicated depends to a considerable extent on the nature and severity of the operation and on the skill of the anaesthetist. For operations on the lower abdomen or lower limbs a low spinal or epidural may provide satisfactory operating conditions with adequate spontaneous respiration, but where the operation is on the upper abdomen the advantages are far outweighed by the respiratory impairment associated with a high block. Further, while an operation on the upper extremity may be satisfactorily carried out under a brachial plexus block or by an intravenous local analgesia technique, these are not devoid of risk and, in particular, the inadvertent production of a pneumothorax during a supraclavicular block could prove disastrous. Attempts to overcome discomfort or allay apprehension, associated with local analgesia, by the use of analgesic and sedative drugs or by light general anaesthesia are liable to accentuate the difficulties by depressing respiration.

In the majority of cases, therefore, a general anaesthetic is preferred, attention being directed towards the prevention or control of ventilatory insufficiency by measures aimed at maintaining a clear, unobstructed airway and ensuring that the alveolar ventilation is adequate to provide efficient oxygen uptake and carbon dioxide excretion.

The induction of anaesthesia by inhalational agents is often slow and difficult in patients with respiratory disease, due to the fact that there is frequently impairment of diffusion and uneven ventilation associated with a large functional residual volume and consequently delay in the uptake of anaesthetic gas or vapour by the pulmonary capillary blood. Except in severe asthmatic patients, where the risk of accentuating bronchospasm is increased, anaesthesia is, therefore, usually induced with sodium thiopentone and intubation carried out with the aid of a muscle relaxant drug.

In many cases of disturbed respiratory function, especially in those with advanced emphysematous changes in the lungs, it may be difficult to decide whether the anaesthetised patient should be allowed to breathe spontaneously or whether controlled respiration should be employed. Both methods have possible hazards

and the best technique for the individual case must be decided after taking into consideration the extent and nature of lung damage and the site, duration and severity of the operation. The anaesthetist must attempt to produce satisfactory operating conditions compatible with the safety of the patient but, at the same time, he must bear in mind the risk of post-operative complications, particularly the difficulty of establishing efficient spontaneous respiration at the end of the operation. Where the operation is one requiring little relaxation neuromuscular blocking drugs can be avoided and satisfactory operating conditions may be achieved with the patient breathing spontaneously throughout. On the other hand, the majority of operations will require a degree of muscle relaxation and this can be most safely produced by the specific muscle relaxant drugs. In these circumstances the risk of hypoventilation is paramount and efficient controlled respiration is obligatory. Many anaesthetists would go further and consider that, except for the most minor procedures, all patients with severe respiratory disease benefit from efficient controlled respiration which eliminates impaired thoracic movement and reduces uneven ventilation and defective gaseous exchange in the lungs. They believe that, if ventilation was adequate before operation, the use of controlled respiration will not increase the difficulty of establishing efficient spontaneous respiration at the end of the operation.

The main problems in anaesthesia for asthmatic patients are related to the evacuation of secretions and the control of bronchospasm. Excitement and anxiety must be allayed by adequate pre-operative sedation, but care must be taken with the use of opiates and barbiturates which can cause considerable depression of respiration. Drugs, such as thiopentone, cyclopropane and d-tubocurarine, which enhance parasympathetic activity or cause histamine release must be avoided or used with the greatest caution. Pethidine, which has a bronchodilator action, is well tolerated by asthmatic patients and, when bronchospasm is present, 0.25 to 0.5 G of aminophylline may be given by intramuscular injection half an hour before the start of the anaesthetic.

Post-operative period

Following operation, breathing in patients with pre-existing respiratory disease is likely to be further impaired. Attention should, therefore, be directed towards the prevention and correction of such causes of hypoventilation as residual muscular paralysis due to relaxant drugs, central respiratory depression by analgesic drugs, and respiratory obstruction and restriction of chest expansion by tight abdominal binders or bandages round the chest. Besides dealing with these immediate causes of hypoventilation, the chest should be regularly examined, if necessary with the help of radiography. Occasionally a pneumothorax, from the rupture of an emphysematous bulla or other cause, may occur and, especially when this is under tension, it may be necessary to insert an intercostal drain to evacuate air under a water seal until full re-expansion has occurred. After abdominal, and particularly upper abdominal operations, lobular or lobar atelectasis may develop. The risk is increased in cases with pre-existing respiratory disease where sticky secretions are present. This condition usually develops within the first few days after operation and demands immediate and strenuous efforts to ensure re-expansion of the collapsed lung tissue. The type of anaesthesia is unimportant as a cause of these chest complications, the incidence being the same in cases who have received regional as in those who were given a general anaesthetic.

Occasionally these factors causing hypoventilation are severe enough to cause features of carbon dioxide retention and hypoxia and the condition of ventilatory failure develops. Tracheostomy facilitates the removal of secretions and may decrease dead space sufficiently to increase alveolar ventilation and make gaseous exchange more efficient. If ventilatory inadequancy is still present, however, it will be necessary to institute some form of intermittent positive pressure ventilation to tide the patient over the immediate post-operative period.

Conclusion

It would seem probable that many of these problems associated with anaesthesia in patients with concurrent disease of the cardiovascular or respiratory systems are likely to increase in the future with greater life expectancy and further advances in therapeutics. It is, therefore, incumbent on all physicians, general practitioners, surgeons and anaesthetists to be on the constant lookout for new hazards in patients who are suffering from intercurrent disease.